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PROGRESS IN FEDERAL-GRANT FUND RESEARCH
IN THE STATE AGRICULTURAL EXPERIMENT STATIONS.

1940

Federal-grant funds are administered and expended by research projects. In the sense used, a research project is rather specific in objective, constituting a research attack for benefit of agriculture largely on problems of economic importance that farmers submit for solution.

Benefit to agriculture does not imply necessarily a complete solution and elimination of the problem. Biologic factors as well as economic factors, including social factors and agricultural geography, are constantly changing. Where there is such constant change maximum benefit to agriculture calls for research by specific narrow line projects and completion or termination of the research when the specific objective is accomplished or when it is clear that the research has reached a point of diminishing returns.

Though restricted to such specific problems research still constitutes a study of the unknown. Occasionally but rarely the specific objective can be accomplished and the project closed in a year or a few years. Ordinarily the active period of a project is longer--an average of about 10 years for the Federal-grant projects.

With this explanation it follows that research findings which reach the stage of practical significance within any one year are in part the accomplishments of the current year and in part the accumulation of progress of several years. However, there should be and there are accomplishments of practical significance annually.

The following are selected examples reported for the year 1940; selected not necessarily as the most important to agriculture in the long run but as those having tangible values of a nature to be most readily understood.



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Improved Plants through Breeding.--Further marked advances in the improvement of crop plants through breeding and selection have resulted from the work of the Minnesota Station. New corn double crosses of higher yielding ability, smut resistance, and capacity for withstanding lodging than the recommended station hybrids now being grown are being increased for use in the several sections of the State. The first improved varieties of flax resulting from hybridization in the United States are represented by two selections of crosses of Bison with other flax varieties now being increased for distribution. They approach Bison in seed size and oil content and have the high iodine number and oil quality of the other parent. Progress is being registered in breeding a new and superior hard spring wheat with the high baking qualities and stem rust resistance of Thatcher, but also resistant to leaf rust which may cause losses in yield and quality equivalent to \$9 per acre. A high quality winter apple, Prairie Spy, and a hardy blight resistant pear, Bantam, produced after 25 years of breeding and testing, were named and made available for distribution.

Progress in Alfalfa Breeding.--Tangible results are being obtained in the search for new varieties of alfalfa for use in areas where bacterial wilt is seriously affecting stands. In a cooperative breeding and testing program between some 40 States and the U. S. Department of Agriculture, five outstanding strains with respect to cold and bacterial wilt resistance and forage and seed productivity have been selected for seed increase. Final cold and wilt resistance tests are being made on these strains and those which meet certain standards will be combined for commercial use. The Nebraska Station in supplementary studies directed to the problem of seed production has found that alfalfa flowers rarely set seed without being tripped by insects. The presence of beneficial insects in alfalfa fields which are to be left for seed is thus shown to be of major importance. Hybridization with the "spreading" or pasture type of alfalfa appears promising but no seed stocks of this type are available as yet.

Value of Cotton Breeding.--Increased yields and premiums estimated at \$2,125,000 were realized in 1939 by Georgia cotton growers through the planting of improved varieties of cotton in one-variety cotton communities. The one-variety community plan was started in 1931 when the Georgia Experiment Station in cooperation with the Bureau of Plant Industry produced about 4 tons of seed of Stoneville No. 2 and placed it in the Orchard Hill Community in Spalding County. From this beginning the one-variety community program had increased by 1939 to 181 communities in 75 counties which produced 182,549 bales of cotton.

Spreading of Cactus by Rabbits.--The rapid spreading of cactus in western Kansas during the past seven years of drought has caused much concern. The real cause of the spread was not known until workers at the Fort Hays branch of the Kansas Experiment Station discovered that jackrabbits feed heavily upon the ripened fruits of the cactus and that germination of the seeds is increased and speeded-up by passage through rabbits. Rabbit droppings were found to contain as many as 15 cactus seeds with an average of 4.

Improvement of Potato Seed Stocks.--Largely as a result of cooperative research of the Maine Station and the U. S. Department of Agriculture there was a greater demand for and sale of Maine potato seed in 1940 than ever before. The methods of producing high-yielding, disease-free seed worked out through a number of years of investigations give assurance of an annual income of several million dollars to the potato industry of Maine and help potato areas outside the State which use Maine-grown seed stock. These studies have developed the information that foundation seed stocks should be planted early by the tuber unit method in rigidly isolated areas, rogued early and carefully, kept free of weeds, and sprayed thoroughly with a spray that does not mask the symptoms of virus diseases. Seed should be stored so as to avoid other diseases such as bacterial wilt. Recent results of the station's research point to a reduction of about 80 percent of the cost of materials used for seed treatment by prolonging their effective use and assure greater certainty of the effectiveness of the treatment. Solutions of mercuric chloride used in seed treatment lose their antiseptic qualities after 4 or 5 lots of seed have been dipped in them. When 1 percent acetic acid or hydrochloric acid is added to the solution it remains effective even after 25 dips.

Grass Improvement for Hawaii.--Some of the large perennial forage grasses are ideally adapted to Hawaiian conditions, often yielding 100 tons of green forage per acre. Their full possibilities are largely unexplored. Since many of these grasses are extremely variable the Hawaii Station is making selections and crosses looking towards their improvement for use in beef fattening when supplemented with molasses and protein. Selections of Guinea grass for vigor and adaptability, and of Sudan grass for vigor and rust resistance are showing promise. Crosses between Napier and Merker grass are giving higher yields, more rapid recovery after cutting, and more resistance to the eye-spot disease than ordinary Napier grass. Experiments with species of Paspalum and Pennisetum of importance in pasture improvement have shown marked increases in germination by soaking the seed in water or by treatment with acids.

Irrigation Requirements for Cotton.--The best use of water for cotton in the southern irrigated valleys of New Mexico is important since cotton is one of the major cash crops of the area and water supplies are limited. Valuable information on the effects of time of application and different amounts of water on yields of cotton has been secured in experiments of the New Mexico Station. It has been found that from 24 to 28 inches of water properly distributed through the season results in as good yields as larger amounts. The largest number of blooms and of bolls was obtained by frequent applications during the blooming period. Excessive moisture supplies late in the growing season delayed maturity and the sparing use of water during this period with frequent applications in the forepart of the season produced larger yields than the reverse of this procedure.

Darkening of Potato Tubers.--One of the serious problems confronting potato growers is that of darkening of the tubers after cooking. Progress has been made during the past year by the Cornell Station which offers hope that a solution of this problem may be obtained within the near future. Potatoes were grown in normal light, others were shaded during a portion of the time in August and September. Fertilizers varying in nitrogen, phosphorus, and potash content were applied at the rate of one ton to the acre. Very little blackening developed in any of the tubers grown in normal light or in the shaded plots which received no nitrogen. There was marked darkening, however, in tubers grown on shaded plots which received additional nitrogen. This is the first time that darkening of potatoes has been produced experimentally.

A Small Electric Milk Pasteurizer.--Pasteurization of milk in small quantities by the producer who supplies milk for the numerous villages and towns in the United States has long been a problem. At least one State has passed a law requiring pasteurization of all fluid milk offered for sale, and others will no doubt follow with similar legislation. Present pasteurizers are largely of the steam or hot water type, are too expensive for the small producer, and require considerable auxiliary equipment. A pasteurizer has been completed by the Maryland Station, after considerable experimental work, which shows much promise. Initial tests show that it can pasteurize 10 gallons of milk with approximately 2.3 kilowatt-hours of power. Used in connection with a dairy producing the milk it could handle up to 40 gallons per day by using it twice daily and pasteurizing two lots at each milking. At prevailing prices for electricity, the cost of operating this small unit would be considerably lower than that of steam or hot water units. Tests are now being conducted to determine the effectiveness of pasteurization and the effects on the milk chemically. Final development of such a unit appears very near.

Tractor Hitches for Horse-drawn Machinery.--The use of tractors has increased to such an extent that horse-drawn machinery is on the bargain counter in many States. In order to permit farmers to use their horse-drawn machinery with tractors the South Dakota Station has worked out methods of remodelling the hitches so they can be operated efficiently with tractor power. Simple and effective modifications for grain binders and corn cultivators have been devised. An appreciable saving in new outlays for farm machinery can be made through the use of these tractor hitches.

Use of Electricity in Feed Grinding.---The Kansas Station estimates that farmers of that State spend over \$4,000,000 annually for prepared feeds for livestock and poultry. Since there are now more than 5,000 Kansas farms connected to high electric lines the use of electric motors in grinding home-grown feeds equal or superior in quality to brands of ready-mixed feeds offers a profitable field for investigation. The station finds that the small burr mill and the small hammer mill, when powered by a 1 or a 1-1/2 horsepower motor have sufficient capacity for the average farmer and give almost troublefree performance. The cost of energy with the rate at 2 to 3 cents per kilowatt hour compared very favorably with the cost of fuel for a tractor.

Acid Treatment of Cotton Seed.---In Arizona some 500 tons of cotton seed, sufficient for planting 50,000 acres, were treated in 1940 with the sulphuric acid method developed by the Arizona Station. By removing the fuzz from cotton seed the acid treatment permits an appreciable saving in seed for planting since delinted seed give vigorous, healthy stands at planting rates of 7 to 15 pounds per acre as compared with 25 to 60 pounds of fuzzy seed. The treatment is also effective in controlling the angular leaf-spot and Verticillium wilt diseases. Excellent results are also reported from 3 other States using this treatment.

Strawberry Root Diseases.---The annual value of the strawberry crop in Maryland is close to \$1,500,000 and production of that crop is an important industry in a section of the Eastern Shore. In recent years, this crop has been threatened by a root disease known as red stele. Breeding and selection for resistance to red stele has been conducted by the Maryland Station in cooperation with the U. S. Department of Agriculture. All of the named varieties obtainable and about 5,000 hybrid clones have been tested for resistance to red stele during the last two years, and others will be tested in the future. Out of all of these tests, at least one variety, Aberdeen, and a number of hybrids have been free from red stele, even when grown under the most favorable conditions for infection. The investigations indicate that all of the more important commercial varieties of strawberries may be replaced eventually by immune varieties of about the same quality.

Breeding Tomatoes for Disease Resistance.---Noteworthy progress in the control of two destructive diseases of tomatoes, Verticillium wilt and curly top, is being obtained by the Utah Station in cooperation with the BPI through the crossing of recently introduced species from South America with North American commercial varieties. The early development of a tomato with satisfactory resistance to Verticillium wilt is promised in the resistance shown by second generation hybrids of Peru Wilt No. 665 by Stone and by Century. Virtual immunity to this disease has more recently been discovered in two other species of Lycopersicum from South America which have been added to the stock of breeding materials. Some of the recent South American introductions have been shown to carry a much greater degree of resistance to the curly top disease than species heretofore available, reviving hope that an early solution of the curly top problem may result from crosses with varieties of the cultivated species of tomato.

Soybean Flour Useful in Spray Materials.--A further outlet for the soybean is made possible through the discovery that soybean flour is a useful addition to several orchard spray materials. Experiments by the Virginia Station show that the likelihood of spray injury from Bordeaux mixture and lime-sulfur is reduced by the use of one-half pound of soybean flour in 100 gallons of these spray solutions. Spreading and sticking qualities are improved. Soybean flour may also be used as the emulsifying agent in the preparation of all types of oil emulsions and in the homemaking of dry-mix sulfur-lime, and wettable sulfur. A mixture of soybean flour and manganese sulfate has been found useful in preventing the chemical reaction and injury to fruit and foliage that usually occurs when lead arsenate is added to lime-sulfur solution. While greater safety, improved control, and reduced cost of orchard spraying have been the principal objects of the Virginia Station studies, the producer of soybeans may profit in the development of a new market.

A Coffee Immune to the Leaf-Miner.--The coffee leaf-miner is one of the most serious enemies of coffee in Puerto Rico. Artificial control measures have not been effective. The discovery of immunity to its attack in a species of Coffea is, therefore, unusually significant since it may lead to the development of commercially resistant strains through hybridization. Under favorable greenhouse conditions, an Arabian coffee (Coffea stenophylla) proved immune when exposed by University of Puerto Rico Station workers to attack by the leaf-miner. Eggs were laid normally on the leaves, but most of the caterpillars either failed to penetrate the leaf or died soon after eating leaf tissue.

Control of Grape Plume Moth.--The value of a thorough knowledge of the life history of an insect in the working out of control measures is illustrated in research on the grape plume moth by the Massachusetts Station. In tracing the complete life history of this insect it was found that the eggs, which previously had not been described, are laid singly in the axils of buds or branches on the older canes. Experiments based on a knowledge of this fact led to the discovery that satisfactory control could be obtained with a dormant spray of either a 3 percent oil emulsion or 1 percent sodium dinitro cresylate. This is the first record of an efficient control of the grape plume moth applicable to either home plantings or commercial vineyards.

Determination of Grasshoppers through Egg Characteristics.--As a result of a recently published study by the Kansas Station, it is now possible for the first time to identify accurately the eggs of 48 common species of midwestern grasshoppers. This work is already proving helpful in grasshopper surveys and control programs since it is now possible to determine certain females of some closely related economic species, otherwise indistinguishable on the basis of external characteristics, by removing eggs from their abdomens and identifying these.

New Spray for Citrus Thrips.--Citrus thrips have become an important pest of lemons during the past few years. Efforts to control them were without important success until a method was developed by the California Station of using sprays and dusts composed of stomach poisons combined with sugars. Sprays containing one pound of tartar emetic and two pounds of sucrose per 100 gallons of spray, tested in widespread field experiments, have proved more effective and less expensive than previous methods employed. As a result, thousands of acres of California citrus have been sprayed with the tartar emetic-sucrose combinations and excellent results have been obtained.

Find Compound which Prevents Blood Clotting.--A finding of importance to agriculture and possibly to medicine appeared during the year in an announcement that Wisconsin Station biochemists had isolated and identified a compound which destroys the clotting power of the blood in certain animals. The compound, a coumarin derivative, is the cause of "sweet clover disease" of cattle. Cattle which get large amounts of the compound in partially spoiled sweet clover often bleed to death from slight wounds or from internal hemorrhages. In tracking down the cause of the sweet clover disease the anti-blood clotting factor was found among some 60 naturally occurring coumarin derivatives. The possibility is raised that this novel and potent compound may prove valuable in treating human diseases caused by or complicated by blood clots.

Prevention of Hemorrhages.--Several years ago research workers at the California Station and in Denmark simultaneously discovered vitamin K, the so-called anti-hemorrhagic factor. This substance protects chicks against severe hemorrhages and has been found valuable in preventing the serious hemorrhages which often follow cases of obstructive jaundice in humans. The California workers, after determining the chemical structure of the new vitamin, succeeded in synthesizing it in the laboratory. They now have found a number of simpler and cheaper compounds which are as effective as the pure vitamin and which are finding uses in a number of medical clinics.

Improved Preservation of Fruit Juices.--The removal of air from fruit juices before bottling or canning results in marked improvement in quality and in the preservation of ascorbic acid (vitamin C) and carotene values according to studies of the Massachusetts Station. Undesirable changes in fruit juices were found to be due chiefly to the presence of oxygen in the headpiece of the bottle or can which disappears in 15 to 40 days, depending upon storage temperature. Oxygen reacts with the ascorbic acid in the juice and its loss parallels the disappearance of the oxygen. Undesirable flavor and color changes also accompany oxygen disappearance.

Aid in Early Marketing of Nursery Stock.--The Oregon Station has discovered an effective and harmless method of defoliating roses and other nursery stock which permits earlier marketing than is possible when natural processes of maturity are relied on. The plants are exposed at the time of digging to minute quantities of ethylene gas, either prepared artificially or given off by such fruits as apples and pears during ripening. Defoliation by this method is followed by normal maturity and no injury has been reported.

Calcium Sprays Reduce Cracking in Sweet Cherries.--Still in the experimental stage but of considerable promise as means of reducing cracking in sweet cherries, are sprays containing calcium in any one of several forms. According to experiments of the Idaho Station, sprayed cherries and cherries that have been immersed for short periods in solutions of calcium compounds absorb water much more slowly, and, therefore, crack less readily than untreated fruit. While several forms of calcium have proved more or less effective for this purpose, the most promising one from a practical standpoint seems at present to be calcium hydroxide (hydrated lime). Sprays containing 12 pounds of lime in this form in 100 gallons of water have materially reduced susceptibility of sweet cherries to cracking under field conditions. In this proportion only a small percentage of the lime goes into solution, but there is a definite advantage in having a surplus of lime that will leave a heavy residue on the fruit. In rainy periods following the application of the spray some of this residue goes into solution and the fruit is subjected to additional treatments with soluble calcium, which further reduces its rate of absorption of water. Residues remaining on the fruit at harvest time following the use of calcium sprays constitute an objectionable feature of such treatments. Residues of hydrated lime are rather easily removed by a spray containing 1/2 percent of acetic acid, which must be followed immediately by a rinsing spray of water. A washing treatment consisting of a bath in a 1/2 percent solution of acetic acid followed by a water rinse also is effective, but under commercial conditions, it would be necessary to provide means of drying the fruit before packing. Until these problems are worked out and the sprays are made more effective, calcium treatments to reduce cracking cannot be recommended for commercial use, but the results to date point to an eventual practical solution of the important problem of fruit cracking in cherries.

Sugar Content of Sweet Corn Inbreds and Hybrids.--Studies by the Indiana Station in cooperation with the Department have shown that inbred lines and hybrids of sweet corn have marked differences in initial sugar content and the rate at which the sugar disappears on storage. These findings will have great value to plant breeders in developing better strains of sweet corn for commercial use.

Grafted Grapes Best for Southeast.--Although it has been shown that grafted vines are superior to those on their own roots in other grape-growing sections, the grafting of grapes on resistant stocks appears to be absolutely essential for successful culture of northern type grapes in the light soils of the Southeast, according to experiments of the South Carolina Station. Dog Ridge has proved especially good as a stock, being relatively immune to the root-knot nematode. Rupestris St. George has also been found satisfactory. Certain varieties have shown especially striking benefits from grafting. Delaware, a weak grower but otherwise adapted to the South, has trebled in yield and growth. Concord, which normally ripens unevenly in the area, has shown a marked improvement in this respect on grafted vines. In general, the quality of the fruit of other varieties is superior on grafted vines as to color, size, and compactness of bunches. These outstanding results should permit the extension of grape culture to the Southeast and provide a new type of local grown fruit for use in southern diets.

New Lima Bean.--The breeding by the Illinois Station of the Baby Potato Lima Bean was given public recognition when this variety received the highest award, a silver medal, in the 1940 All-American Selections by the Council of the Seed Trade Associations of North America.

New Growth Stimulants.--The West Virginia Station is approaching the problem of controlling plant diseases through fundamental studies of the nutrition of the fungi and of the flowering plants which they attack. Special attention is given to the chemical substances that promote or hinder growth. An interesting new discovery which may have considerable practical value in the production of greenhouse crops is the finding that the growth of corn and tomato plants was greatly increased when sodium malate, in the presence of organic matter, was added to the medium in which the plants were grown. Since the growth stimulation occurred only during periods of little sunshine and was not observed when sunshine was adequate, it is believed that sodium malate had the effect of increasing photosynthesis. Experiments are under way to determine this more accurately.

Cottonseed Meal for Dairy Cows.--That cottonseed meal may be fed in almost any desired quantity in the dairy ration without injury so long as sufficient vitamin A is supplied has been established through experiments extending over a number of years by the Oklahoma Station in which dairy cows have been confined to a ration of cottonseed meal and prairie hay for several consecutive lactation and gestation periods. This finding is of great economic importance not only to Oklahoma but to the entire cotton-producing area in which cottonseed meal is the cheapest and most readily available source of protein for livestock feeding. Cottonseed meal frequently sells at a lower price per ton than the common grain feeds in this area, and hence competes with other feed stuffs as a source of total nutrients as well as being the major source of protein.

Palatability of Hybrid and Open-Pollinated Corn.--The increasing attention being given to the question of the palatability of animal feeds has prompted the Ohio Station to study the preference of pigs for varieties of corn. In feeding trials where pigs were given access to four hybrid and four open-pollinated corns a marked preference was shown for some varieties over others, more of one variety being eaten than of all the other seven combined. There was no apparent relationship between palatability and whether a corn was a hybrid or an open-pollinated variety, but there was a close correspondence between moisture content and palatability. Varieties of low moisture content were preferred. From a feeding standpoint, therefore, varieties sufficiently early to mature in normal seasons should be chosen. The hybrid corn compared favorably with open-pollinated corn in feeding value, seven comparisons showing values of 90 to 108 percent for the hybrid as compared with open-pollinated varieties. Trials by this station further indicated that there was no significant difference in the value of hybrid and open-pollinated corns for fattening steer calves.

High Values in Dried Grass Clippings.--The possibility of substituting artificially-dried, clipped grass of high protein content in the dairy ration for some of the purchased concentrates has aroused considerable interest among Eastern dairymen. Studies of the Delaware Station show that annual acre yields of grass and clover mixtures are increased by frequent clipping in the immature stage and that protein yields are increased 40 to 60 percent and carotene content 80 percent by artificial drying as compared with usual sun-cured hay making methods. When dried clipped grass was substituted for all other forms of concentrates and valued at \$27 per ton the feed cost of producing milk was reduced 0.4 cents per quart.

Apples for Dairy Cows.--A use for surplus apples as feed for dairy cows is indicated in experiments conducted by the Ohio Station. Satisfactory results were obtained with apples either in the form of silage or raw. In making silage the apples were put through an ensilage cutter with corn stover or partially cured alfalfa. Several combinations of apples and stover gave a palatable silage. When chopped raw apples were fed at the rate of 30 to 36 pounds per day per cow the production of milk was as good as from corn silage on the same dry matter basis. The great relish shown by the cows for the apples was of special interest. There was no indication that they tended to dry up the cows.

The Effect of Vitamin A Deficiency in Dairy Rations on Milk Production.--Many typical symptoms of vitamin A deficiency in farm animals are well established. The Texas Station found that milk production is markedly affected by the vitamin A content of rations, cows receiving a sub-optimal amount producing about 10 percent less than comparable animals receiving an adequate amount of this factor.

Molasses as a Supplement to Pastures for Fattening Steers.--The Hawaii Station demonstrated that under local conditions much cheaper gains were made by fattening steers on improved native pasture, supplemented with cane molasses than by fattening steers in dry lot, using a maximum amount of such local feeds as pineapple bran, cane molasses, cane bagasse, and pigeon pea meal.

Alfalfa Molasses Silage for Fattening Steers.--In trials at the Kentucky Station steers fed alfalfa molasses silage as a sole roughage made more rapid daily gains than steers receiving an equivalent amount of dry matter in good quality alfalfa hay cut from the same field as the alfalfa for silage, when both lots were full fed equal amounts of shelled corn. These findings tend to confirm those of other stations on the high nutritive value of grass and legume silage preserved with molasses.

The Utilization of Urea in Livestock Feeding.--Experiments at the Illinois Station with growing lambs and at the Wisconsin and Hawaii Stations with growing calves agreed in showing that urea, a non-protein compound, supplying nitrogen at a relatively low cost, was effectively utilized by both classes of animals when fed to replace a considerable portion of the protein in balanced rations. These findings may lead to extensive use of urea in animal feeding since protein concentrates are generally the most expensive constituent in livestock rations.

The Nutritional Value of Dehydrated Sweet Potatoes.--Feeding experiments with dairy cows and with laying hens at the South Carolina Station demonstrated dehydrated sweet potatoes to be an effective source of nutrients when fed as a partial substitute for grain feeds. The vitamin A potency of milk and eggs was markedly increased by the inclusion of the dried sweet potato in the rations. These findings are particularly significant in view of the potential use of sweet potatoes as a livestock feed throughout the South.

Dried Grapefruit Pulp in Cattle Rations.--Experiments at the Florida Station have shown dried grapefruit pulp to be fully equal to dried beet pulp when fed as a part of the mixed ration for dairy cows. A large percent of the refuse from grapefruit canneries is being used in this manner as a result of this study.

Grass Legume Silage for Dairy Cows.--Grass legume silage preserved with phosphoric acid proved equal to corn silage for milk production in a trial at the Massachusetts Station. The flavor of the milk was improved when the acid grass legume silage replaced corn silage in the ration.

Supplying Corn with Nitrogen.--For various reasons, nitrogen is rapidly becoming a major limiting factor in Corn Belt soils. Although legume production for the maintenance of nitrogen has been stressed in every possible way, the nitrogen deficiency is steadily increasing. While experiments over many years have shown that wheat and other small grains are easily supplied with commercial nitrogen on a profitable basis, efforts to supply the needs of corn with commercial nitrogen by any of the usual methods of application have persistently failed. Experiments now under way at the Indiana Station strongly indicate that the problem may be solved by plowing under nitrogen when preparing the ground. Yield increases of 46 bushels per acre have resulted from plowing under ammonium sulphate at a rate of 80 pounds of nitrogen per acre. This method of supplying nitrogen promises to greatly reduce the per bushel cost of producing corn in at least a large section of the Corn Belt. Ammonium-sulphate and calcium cyanamid are the best forms of nitrogen adapted to this new type of nitrogen application.

Milk Marketing Information.--Data useful in connection with the metropolitan milk marketing problem have been obtained by the Cornell Station co-operating with the Bureau of Agricultural Economics in studies of the use of milk by low, medium, and high income families in New York City. It was found that high income families use $1/3$ more milk per person than low income families. In high income areas, 40 percent of the milk was delivered by retail route and 60 percent sold by stores; one-fourth was of Grade A and three-fourths Grade B. In contrast for low income areas 15 percent was delivered and 85 percent sold by stores; one-tenth was Grade A and nine-tenths Grade B.

Problems of Sugar Beet Laborers in Colorado.--The Colorado Station in a study of housing conditions, working patterns, and related problems of sugar beet workers has made an important contribution toward clarifying the problem which should enable a more intelligent handling of it. Most of the laborers came from outside the State and their rate of assimilation has been low. The birth rate is high and the yearly income is meager, ranging between \$412 and \$568, including relief. The houses are small, less than 3 rooms on the average, with leaky roofs, defective walls, and poorly fitted windows and doors. Damp, cold floors and the lack of adequate sewage disposal and sanitation contribute to ill health and a high incidence of disease. Lack of household conveniences results in much drudgery for the women and leaves little time for child training or effective home management. The Colorado Station workers see a direct relation between low standards of housing and the families self-respect and participation in community life. Lack of pride in the home contributes to lack of home control and guidance in the development of children which may be expressed in unsocial conduct.

Size of Farms in Relation to Soil Productivity.--A highly significant result in connection with land-use planning was secured by the Missouri Station in studying farm enterprises. It was found that farms with physical productivity somewhat less than average must be approximately 170 acres in size before such farms have enough total production to take care of the tenant's living and operating costs along with the landlord's direct cost. This means that a farm no larger than this would have nothing which could be properly called net rent. Farms smaller than this will not give a tenant his living and costs, and the landlord's direct costs. In a similar analysis of 103 farms of rather low productivity and 103 farms of rather high fertility, the former required 160 acres to cover these minimum costs and the latter approximately 120 acres. This study reveals vividly the necessity of associating land quality from a physical production standpoint with the necessary size of unit to give reasonably satisfactory landlord-tenant relationships.

New Hog Cholera Vaccine.--Although the use of vaccines in the control of hog cholera has been known since 1886, this disease still costs the farmers of the United States some \$500,000 annually for every million hogs produced. The past year has seen the final release on a nation-wide scale of a new tissue vaccine developed by the California Station. The important advantage of the new vaccine, which is made by treating the ground glandular tissues of pigs infected with cholera with eucalyptol, over the present serum-virus is that it eliminates the need for taking active cholera virus into the field and the possibility that the disease will be spread to uninfected herds through vaccination. Known as BTV (Boynton's tissue vaccine), the new vaccine has been tested successfully on more than 100,000 hogs both on the Pacific Coast and in the Corn Belt.

Gains from Better Selection of Ewes.--The possibility of increasing the income of the sheepmen of New Mexico by close to \$1,500,000 through the proper selection of more efficient breeding animals is shown by the results of work in progress at the New Mexico Station. When the roomy, smooth-skinned type of Rambouillet ewe was compared in breeding trials with a heavy-folded, tight-fleeced type it was found that the first type produced 4 pounds more of feeder lamb or an added income of about 30 cents per ewe. The smooth-skinned type of ewe likewise produced an extra half-inch of wool of improved grade and lower shrinkage. The improvement in grade and weight of fleece at current wool prices brought an additional gain in income per ewe of 40 cents. The station's work suggests that similar gains could be obtained throughout the State if the better type of ewe is selected for breeding purposes.

Blackhead Control in Chickens.--The organic chemical, phenothiazine, for which many biological uses have been found, including the control of codling moth in apples and the treatment of certain worm infestations of cattle, sheep, swine, and horses, has been shown by the Washington Station to be valuable in controlling the blackhead disease in chickens. Small doses in individual capsules resulted in almost complete killing and elimination of the parasitic worm which carries the blackhead organism. Massive doses did no harm but were no more effective than lighter treatments. The chemical does not disturb the digestion of the birds, has no effect on the flavor of the meat, and does not reduce egg production appreciably. The cost of treatment is estimated to be but a fraction of a cent per bird. Treatment should be repeated at intervals of one month. Flock medication rather than individual treatment appears to be practical. Chemically, phenothiazine is related to sulphanilamide and is the parent of many important dyes. It is one of the most versatile chemical substances brought to light in recent years by the Department and is particularly useful because of its low toxicity to warm-blooded animals and its high toxicity to certain insects, parasitic worms, and bacteria.

New Aids in Selenium Poisoning.--Two new aids in preventing selenium poisoning of cattle or in overcoming its effects have been worked out by the South Dakota Station as a further step in the solution of this important livestock problem. Work on the preventive action of arsenic has been carried from white rats to dogs and then to hogs and range cattle. The toxic action of selenium was fully prevented when small quantities of arsenic were supplied in the drinking water of rats, dogs, and hogs. Encouraging results were obtained by adding arsenic to the salt for steers feeding on a seleniferous range. Marked improvement in the condition of selenized cattle and a horse resulted when bromobenzene was administered. The selenium content of the blood decreased notably within a few days. Excellent results have also been obtained in the treatment of some human cases of selenium poisoning with bromobenzene. When it is considered that certain rather large areas in the Great Plains are involved in the problem of selenium poisoning the value of these findings from the standpoint of humans and livestock becomes apparent.

A more complete summary of progress and accomplishments of the work of the experiment stations for the year ending June 30, 1939, is embodied in pages 7 to 245 of the Report on the Agricultural Experiment Stations, 1939. This report is prepared annually on the work and expenditures of the experiment stations for submission to Congress as required by law.

More detailed information and recommendations are embodied in the bulletins, circulars, leaflets, and scientific journal articles published by the experiment stations. For the fiscal year 1939, the stations published a total of 883 bulletins and circulars, 2,241 articles in scientific journals, and 662 miscellaneous publications. The average total of such publications annually for the past 5 years has been 3,368.

A monthly list of station publications is issued in mimeographed form by the Office of Experiment Stations and a printed indexed record is issued biennially.

